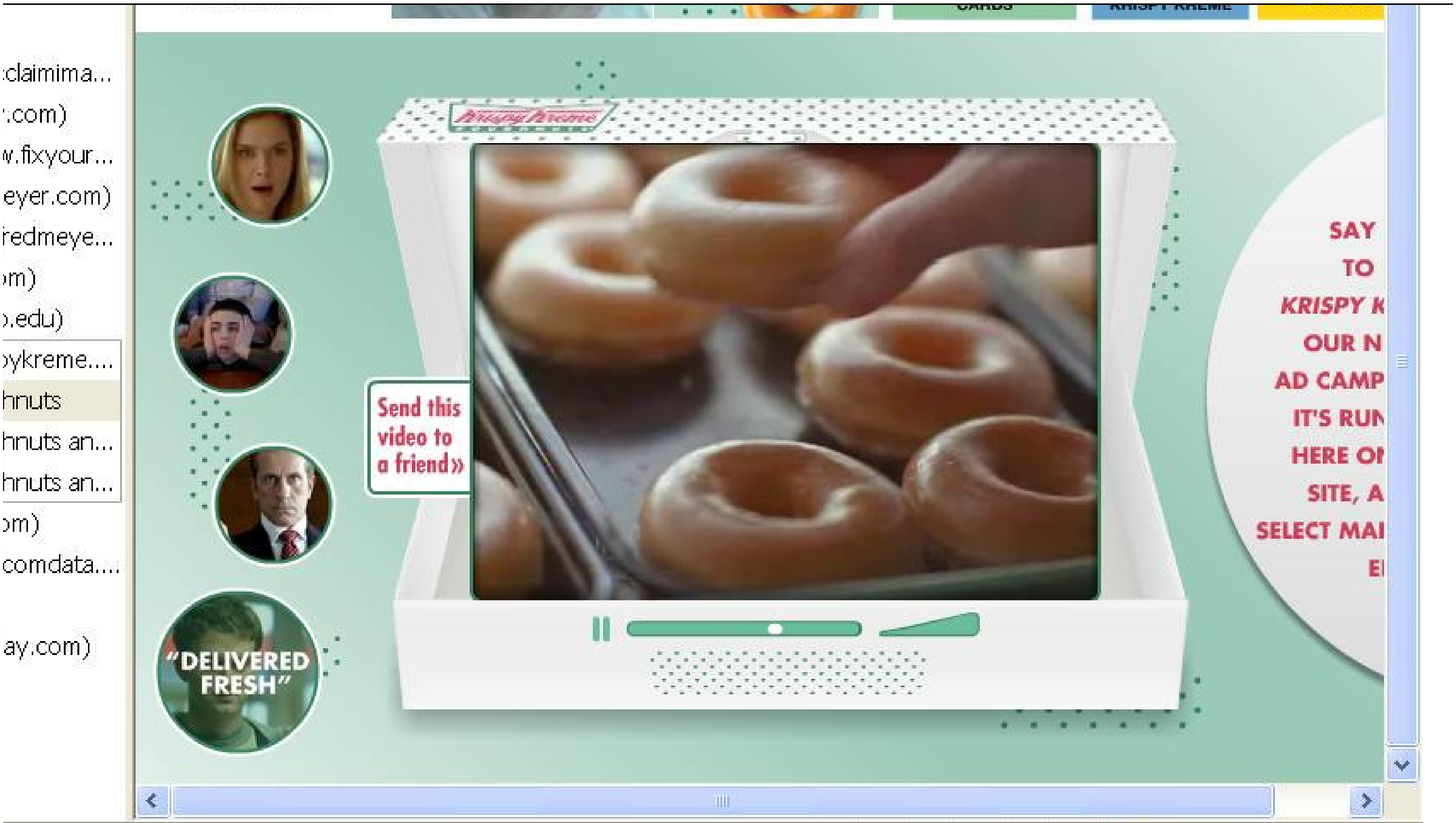
Current Practices Scenario

ESHMC Meeting 8-9 March 2007

B. Contor

Keep our eyes upon the donut…

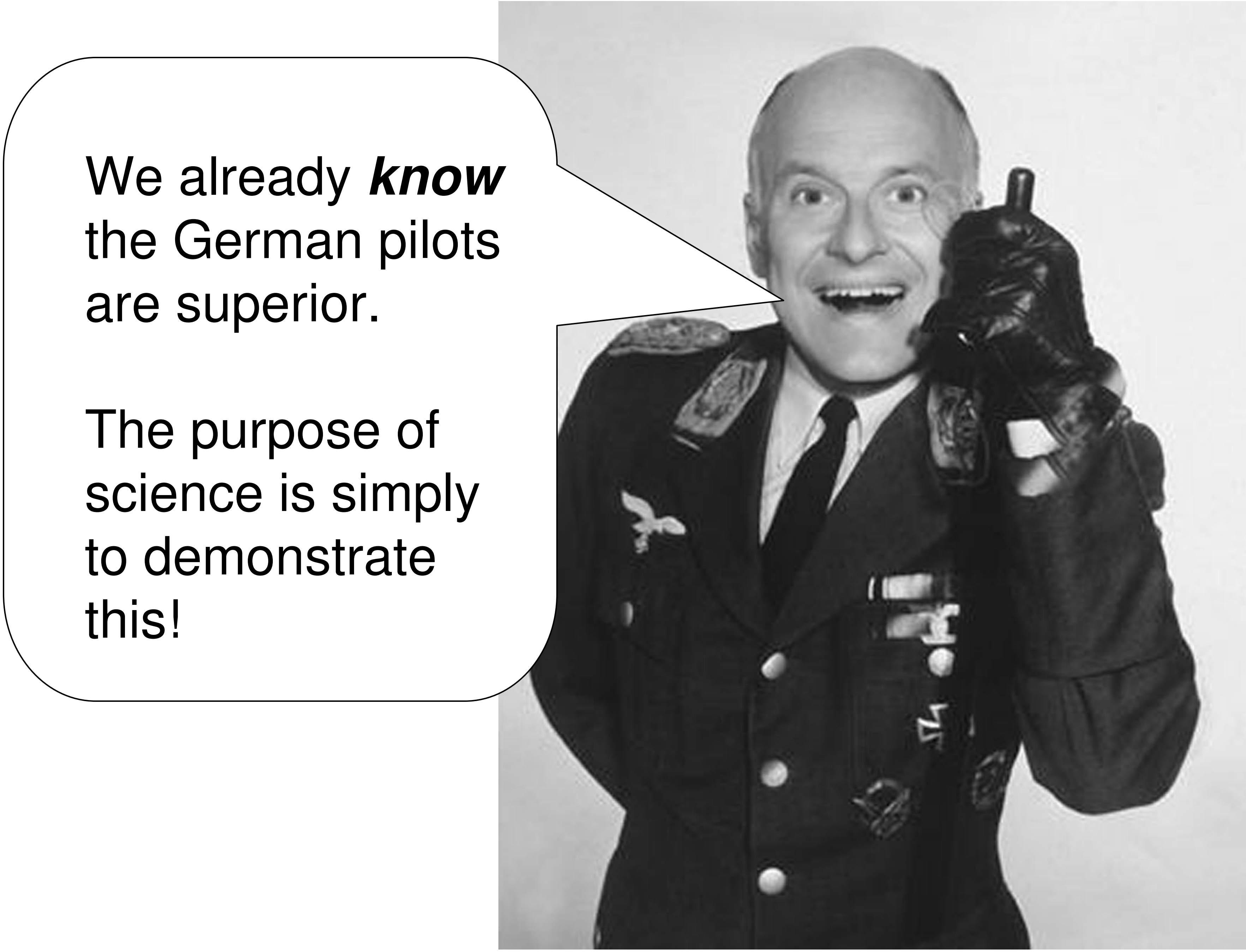


What is the donut?

CORRECT AVERAGE STRESS

Why is this the donut?

Clink, this isn't a fair comparison. The simulators all have German instruments; our guys will be at a disadvantage in the flight tests.


We already ***know*** the German pilots are superior.
The purpose of science is simply to demonstrate this!

Outline of Proposed Scenario

- Title: Current Practices Scenario
- Purpose:

  Predict effect on discharges, gains and heads if current practices & average conditions were to prevail
- Based on current conceptual model & ESPAM 1.1 methods

- Both an end point ("where would we wind up") and trajectory ("how fast would we get there")
  - Implies *transient run*
  - Transient requires starting heads
    - make sure the trajectory starts from *where we are now*
    - starting heads implicitly include the effects of all past stresses in the aquifer

- Proposal for starting heads for *SCENARIO*
  - use short model run to build starting heads as of 1 April 2007
    - starting heads *for the short run* from end of calibration period (implicitly includes all prior stresses)
    - recharge for short run is synthetic blend of actual data and estimates
  - compare to available measured data
    - *not* an effort to fine-tune
    - looking for blunders

Note: Q = f(heads, parameters)

For a given set of parameters, if *heads* are correct, Q will be as correct as it can be.

Input Data

- Scenario requires *input data* (water budget)
  – propose extracting input data from calibration data set
  – keep our eyes upon the donut

CORRECT AVERAGE STRESS

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CORRECT ENDPOINT

- Proposed Candidate Pool for Data
  - 1992 – 2001 well terms
    - don’t use earlier years ‘cause practices were different
    - don’t use later years ‘cause data are partially synthetic and errors or blunders will propagate to end result
    - no adjustments – too much danger of blunders or errors *and no way to detect them*
  - Select combination(s) of years from this pool

Index

- We need an *index* to guide selection
  - keep our eyes upon the donut

CORRECT AVERAGE STRESS

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CORRECT ENDPOINT

- We need an *index* to guide selection
  - For a given data year, index needs to reflect *that year's hydrologic condition*
    - trib underflow
    - precip
    - non-irrigated recharge
    - diversions on systems w/o storage
    - ET
  - It also needs to reflect the impact of *storage* on *human decisions*
    - diversions on systems with storage = a BIG chunk of total recharge
  - BOTH are important; IWRRI proposes using two indices & satisfying BOTH

- Current hydrologic condition
  - Shouldn’t be too hard

- Human/storage interaction
  - This is a little tougher; put on our thinking caps

- Human/storage interaction
  - We want our index to guide us to years that reflect *current decision processes* with *selected hydrologic conditions*
  - Index = indicator of *hydrologic character*
  - The index has to be *time constant*
    - This means that a year with a certain hydrologic character would have the same index value, whether it occurred in the 20s, 30s, 80s or 90s
    - This means that the index has to be free from any influence that would have changed over time (i.e. free from any human management component)

- Proposed *indices* to guide selection
  - *Current hydrologic condition*
    - **natural flow at Heise during irrigation season**
  - *Storage influences on human decisions*
    - **natural flow at Heise during the previous winter**
  - BOTH are important; IWRRI proposes satisfying BOTH indices

Include other streams?

Use of Indices

- Use of indices to guide selection
  - keep our eyes upon the donut

CORRECT AVERAGE STRESS
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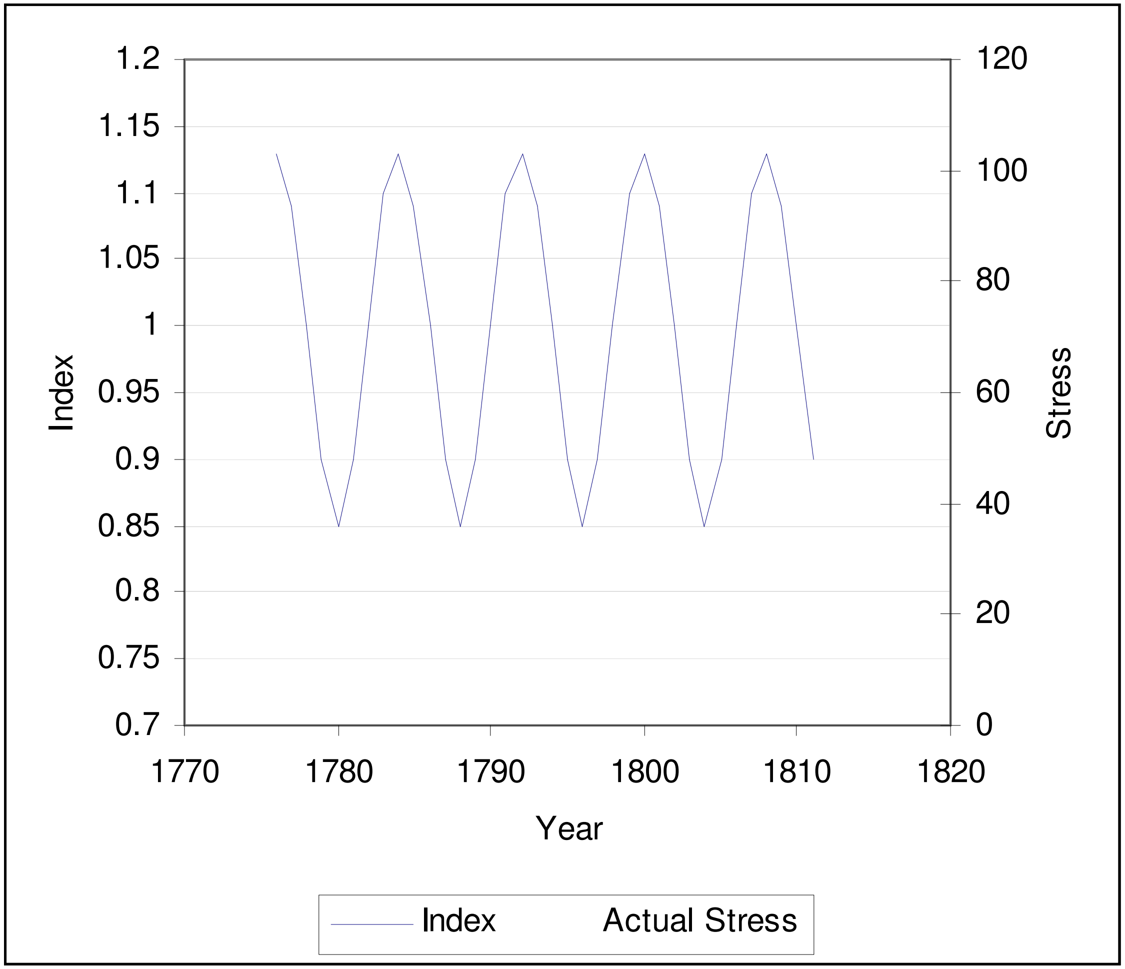
CORRECT ENDPOINT

- Use of indices to obtain average stress
  - Try to get average index ~ 1.0
  - Think about autocorrelation
    - does human response to a “normal” year depend on what the last few years have been like?
    - i.e. what if stress = f(this year, last year, five years ago)?
    - what if index (this year) ~ 1.0 but index (last year, five years ago) >> 1.0 ?
    - This is a ***“correct average”*** concern of autocorrelation

- Illustration

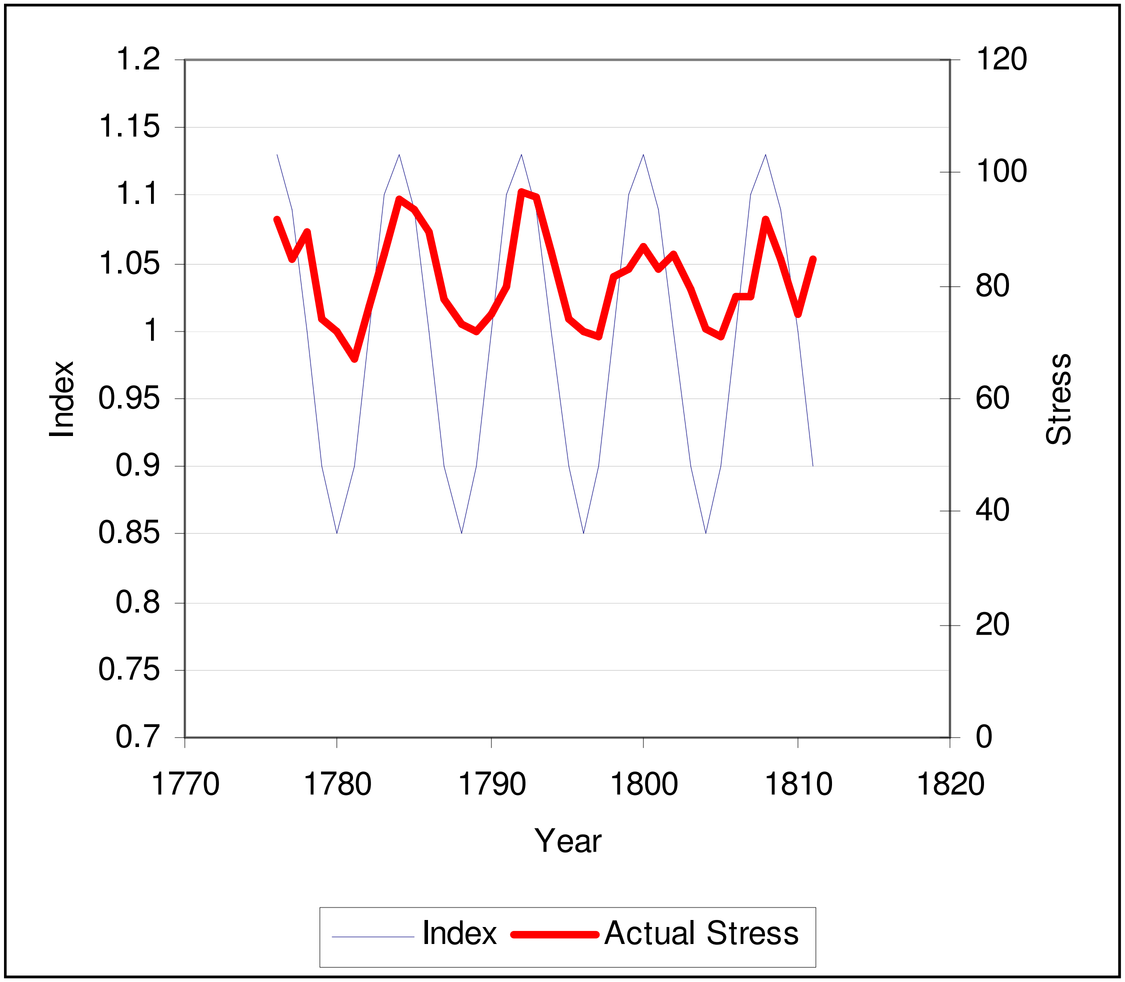


Stress = f(current & past indices & random number)

Which is Best?

Year	Index		Year	Index		Year	Index		Year	Index
1786	1		1791	1.1		1783	1.1		1807	1.1
1786	1		1792	1.13		1792	1.13		1800	1.13
1786	1		1793	1.09		1785	1.09		1801	1.09
1786	1		1794	1		1786	1		1790	1
1804	0.85		1795	0.9		1797	0.9		1781	0.9
1808	1.13		1796	0.85		1788	0.85		1804	0.85
			1797	0.9		1797	0.9		1781	0.9
			1798	1		1786	1		1790	1
avg index	0.997		avg index	0.996		avg index	0.996		avg index	0.996

- Illustration



Stress = 75 * (0.50 index$_{yr}$ + 0.35 index$_{yr-1}$ + 0.15 + index$_{yr-2}$ + random)

Year	Index		Year	Index		Year	Index		Year	Index
1786	1		1791	1.1		1783	1.1		1807	1.1
1786	1		1792	1.13		1792	1.13		1800	1.13
1786	1		1793	1.09		1785	1.09		1801	1.09
1786	1		1794	1		1786	1		1790	1
1804	0.85		1795	0.9		1797	0.9		1781	0.9
1808	1.13		1796	0.85		1788	0.85		1804	0.85
			1797	0.9		1797	0.9		1781	0.9
			1798	1		1786	1		1790	1
avg index	0.997		avg index	0.996		avg index	0.996		avg index	0.996
avg stress	**1.07**			**1.01**			**1.03**			**0.93**

Year	Index		Year	Index		Year	Index		Year	Index
1786	1		1791	1.1		1783	1.1		1807	1.1
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avg index	0.997		avg index	0.996		avg index	0.996		avg index	0.996
avg stress	**1.07**			**1.01**			**1.03**			**0.93**

0.97 – 1.02

•Proposed Criteria:

- Avoid “over-representing” a single year
- Avoid “over-representing” extreme years
- Whenever possible keep years in natural order
- If necessary, add or subtract a year or two to get average index ~ 1.0
- Other things being equal, take a later year in preference to an earlier year

•Proposed Criteria:

- Both indices are important
  - try to satisfy both; (1.02, 0.98) is better than (1.04,1.00)
  - try to balance about 1.0; (1.02, 0.98) is better than (1.02, 1.02) or (0.98,0.98)

Using the Selected Data

•Using selected data:

- Keep our eyes upon the donut
  - **END POINT**
  - Trajectory
  - Variability
  - Uncertainty

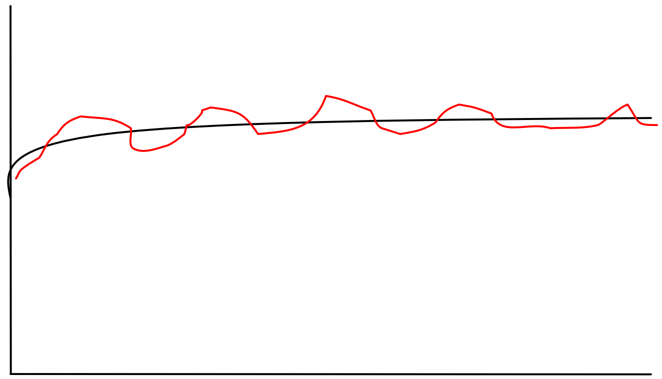
– END POINT

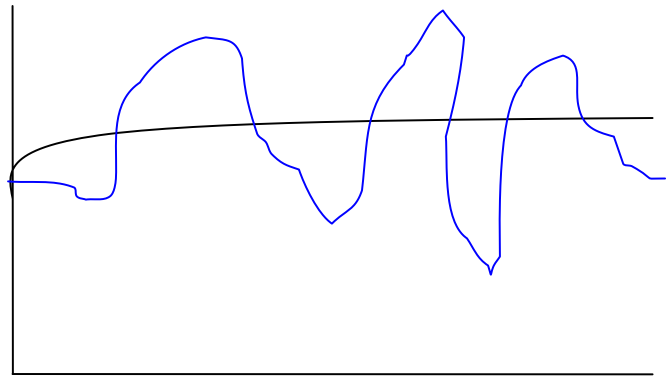
End point is lousy ➔	**Drastic adjustments are needed**
End point is OK ➔	**We're experiencing an acute event**

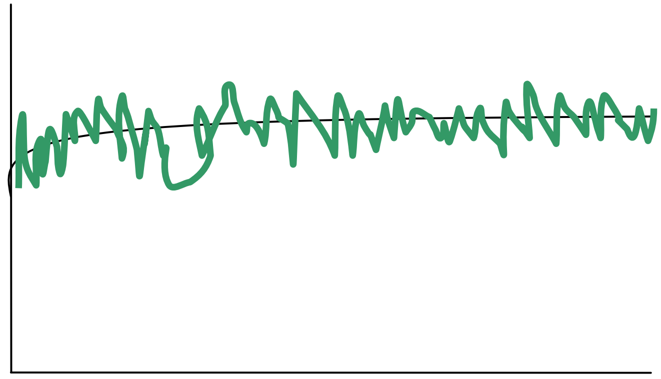
– Present a meaningful discussion of trajectory

Year 10	**20%**	**96%**
Year 50	**25%**	**99%**
Year 100	**30%**	**99.9%**
Year 150	**100%**	**100%**

– Illustrate variability





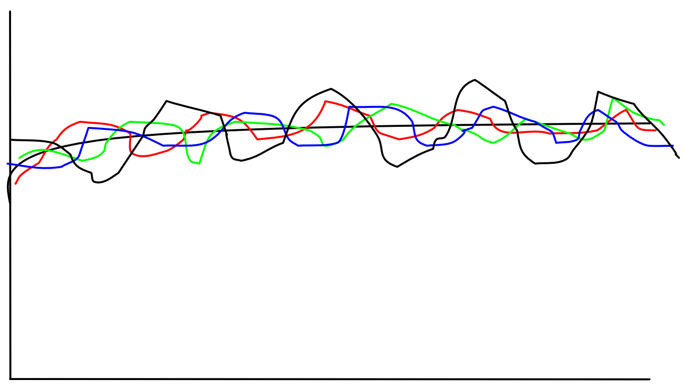


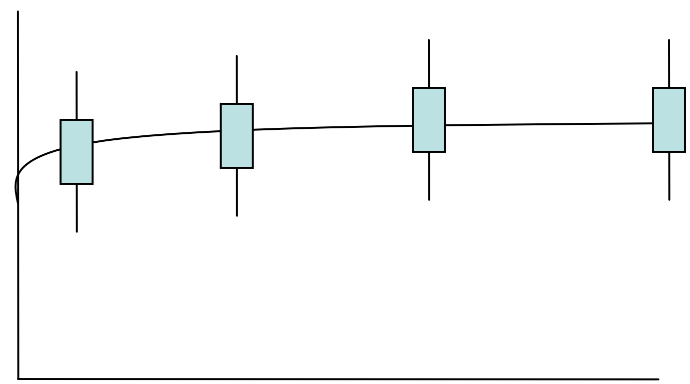
- Address Uncertainty
  - Uncertainty in *model representation*
    - parameters
    - conceptual model
  - Uncertainty in *scenario input data*
  - Uncertainty in future
    - human practices
    - climate

Variability & Methods

– Variability & Methods

- “Multiple Traces” of variable stress representation
- “Constant-stress” (aka “Single Trace”) representation w/ indication of variability from historical obs. Stress is *average* of selected years.





these are conceptual illustrations of CALCULATION, not necessarily of PRESENTATION

- Variability: “Multiple Traces” method
  - If actual range is 0 to 1.0 but “candidate pool” is 0.2 to 0.8, no multiple trace rendition will be able to illustrate full variability
  - Autocorrelation may affect magnitude of extreme events
  - Variability characteristics of synthetic series will be time-constant

– Variability: “Constant Stress” method

- Arguably, historical records are better than a synthetic series
- If historical data suggest *changes* in the nature of variability, our product will call this to users’ attention
- While we would still deal with autocorrelation effects on *average magnitude,* constant-stress method is immune from autocorrelation effects on variability

Uncertainty & Constant-Stress

– Address Uncertainty
- Uncertainty in *model representation*
  - – parameters
  - – conceptual model

Beyond our scope

- Uncertainty in *scenario input data*

- Uncertainty in future
  - – human practices
  - – climate

Beyond our scope

- Uncertainty: “Constant Stress Method”

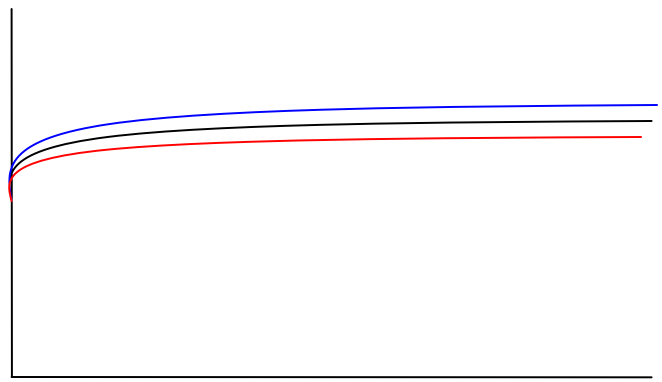
Group 1: 1775 to 1810 with 1809 omitted and 1798 included three times.
Summertime index = 1.02 Wintertime index = 0.98

Group 2: 1776 through 1792
Summertime index = 0.97 Wintertime index = 1.03

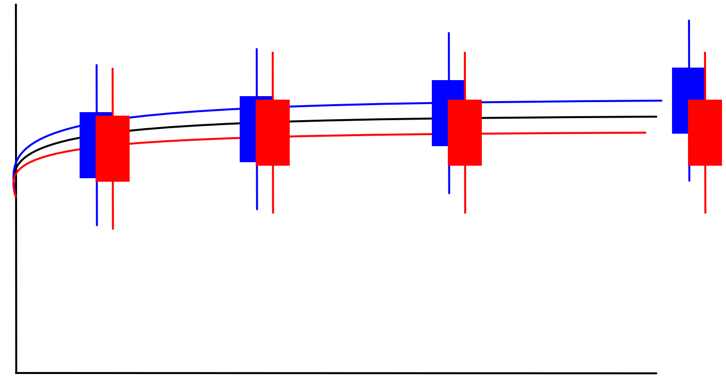
Group 3: 1800 through 1810 with 1802 repeated once
Summertime index 1.01 Wintertime index 0.99

- We would run **all three** simulations to *bound the uncertainty* in the data series

- Combining uncertainty and variability



Step 1: Three “best candidate” series represent data uncertainty



Step 2: Use historical record to represent potential variability

these are conceptual illustrations of CALCULATION, not necessarily of PRESENTATION

Summary

Summary of Scenario

- Title: Current Practices Scenario
- Purpose:

  Predict effect on discharges, gains and heads if current practices & average conditions prevail
- Based on current conceptual model & ESPAM 1.1 methods

Summary of Scenario

- Both an end point ("where do we wind up") and trajectory ("how fast do we get there")
  - transient simulation
  - get starting heads from short model run w/ synthetic data
    - synthetic data set with "real" components
    - compare with observations to check for blunders
    - short run uses ending heads from calibration

Summary of Scenario

- Scenario itself will use data extracted from calibration period data
  - candidate pool 1992 – 2001
  - select based on summertime Heise index and wintertime Heise index (natural flow)
  - satisfy both criteria
  - detailed rules for selection
    - avoid bias

Summary of Scenario

- Selected data (three best groups) will be used to make three best *average stress* well terms
- Three constant-stress simulations to help bound *uncertainty in synthetic scenario data*
  - Model uncertainty not addressed
  - Future uncertainty not addressed

Summary of Scenario

- Hydrologic variability will be extracted from historical record and superimposed on constant-stress results

Summary of Scenario

- Results of scenario
  - End point: What is the implied equilibrium of today's practices (where would we wind up if nothing changed)?
  - Trajectory: How fast would we get there?
  - Data uncertainty: How fuzzy is our knowledge of this endpoint?
  - Hydrologic variability: Along the way, how much "swing" can we expect?

Presentation of Results

- Let’s do the work first

END